

JSC 28035 REVISION A MAY 9, 2001

Lyndon B. Johnson Space Center Houston, Texas 77058 REPLACES BASELINE OCTOBER 1997

SPACE SHUTTLE/SPACE STATION

PROGRAM PROBLEM REPORTING AND CORRECTIVE ACTION REQUIREMENTS FOR JOHNSON SPACE CENTER GOVERNMENT FURNISHED EQUIPMENT

REVISION LOG

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CHANGE SHEET

FOR

JSC 28035 – Space Shuttle/Space Station
Program Problem Reporting and Corrective Action Requirements for
Johnson Space Center Government Furnished Equipment

REVISION A

Program Requirements Control Board Directive No. A096078/(1-1), dated 4/11/01.(1)

May 9, 2001

Secretary, Program Requirements	
Control Board	

Robert H. Heselmeyer

CHANGE INSTRUCTIONS

- This is Revision A to JSC 28035 dated May 9, 2001, which replaces the Baseline Issue dated October 1997. Please discard the Baseline Issue to JSC 28035 and utilize this Revision A in its place.
- 2. Subsequent changes to JSC 28035 will be processed against this Revision A.

 Signature of person incorporating changes

 Date

JSC 28035 - Space Shuttle/Space Station Program Problem Reporting and Corrective Action Requirements for Johnson Space Center Government Furnished Equipment

LIST OF EFFECTIVE PAGES

May 9, 2001

The current status of all pages in this document is as shown below:

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i - x	Revision A	A096078	April 11, 2001
1-1 - 1-2	Revision A	A096078	April 11, 2001
2-1 - 2-2	Revision A	A096078	April 11, 2001
3-1 - 3-2	Revision A	A096078	April 11, 2001
4-1 - 4-12	Revision A	A096078	April 11, 2001
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6-1 - 6-4	Revision A	A096078	April 11, 2001
A-1 - A-4	Revision A	A096078	April 11, 2001
B-1 - B-10	Revision A	A096078	April 11, 2001

SPACE SHUTTLE/SPACE STATION

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Approved by:

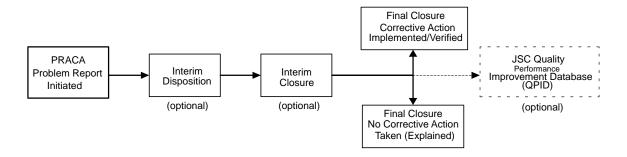
Ronald D. Dittemore

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PREFACE

This document incorporates provisions of NSTS 08126, Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements and SSP 30223, Problem Reporting and Corrective Action for the Space Station Program. It has been tailored from these documents to support both programs and meet the obligations of the JSC corrective action system for timely reporting, determination of a root cause, and implementation and verification of corrective action(s) for problems occurring on JSC provided Government Furnished Equipment (GFE).



Major Milestones of the "Typical" Reportable GFE Problem

Reported problems are processed to ensure that JSC GFE is capable of supporting safe and successful flight and training operations. Once a nonconformance occurs or is detected, the nonconforming item is evaluated to determine if it meets the criteria specified in this document for reporting PRACA problems. Those meeting the requirements are documented on the JSC Form 2174, Failure Investigation Action Report (FIAR) series of forms or NASA approved contractor equivalent. For the purposes of this document, a generic term is used, the PRACA Problem Report (PPR).

As shown in the process above, there are optional steps to the resolution of a problem. In the interest of safety and risk management, an interim disposition must be provided whenever the occasion arises where similar articles to the nonconforming article are going to be used prior to the completion of the problem investigation and resolution. The interim disposition is used to clear an open problem for Flight Readiness Reviews (FRRs).

Additionally, corrective actions are to be implemented and verified effective prior to the closure of a problem requiring recurrence control. In many cases this may take an extended period of time to accomplish. Once technical agreement is reached on a corrective action and a method to verify its effectiveness, an interim closure may be processed and approved. The JSC GFE PRACA database provides a means for tracking these actions and providing management status information, upon request, until a final closure can be provided.

And finally, for that situation where during the problem investigation a generic process issue is identified that has potential JSC center-wide implications, NASA may invoke the JSC corrective action system per the JSC Quality Management System's System Level Procedure (SLP) 4.14, Corrective and Preventive Action.

This document is under the control of the Joint Program Requirements Control Board (JPRCB). Changes to this document must be approved by the JPRCB.

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1.0 PURPOSE

The purpose of the JSC Problem Reporting and Corrective Action (PRACA) system is to provide a closed-loop process for the reporting, processing, dispositioning, and when appropriate, documenting corrective action(s) for problems, as specified below, involving JSC provided Government Furnished Equipment (GFE).

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2.0 SCOPE

This document applies to all elements and sites involved in the manufacture, assembly, handling, testing, use, or repair of JSC GFE, or critical Ground Support Equipment (GSE) provided by JSC. It is applicable to JSC GFE suppliers to the level specified by the contract Data Requirements Document (DRD). The applicability of these requirements also applies to JSC Detailed Test Objectives/Detailed Science Objectives.

These requirements are not applicable to Department of Defense classified equipment, payloads or payload GSE. All International Space Station (ISS) payload problems are to be reported and processed per SSP 50431, Space Station Program Requirements for Payloads and SSP 30223, Problem Reporting and Corrective Action for the Space Station Program, and worked in the ISS PRACA Data System.

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3.0 DOCUMENTS

3.1 APPLICABLE DOCUMENTS

The following document's latest revision form a part of this document to the extent specified herein. In the event of a conflict between the documents referenced herein, the contents of this specification is considered a superseding requirement.

NSTS 08126 (Current Issue)	Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements		
	Ref. Preface, Para. 6.7h		
NSTS 22206 (Current Issue)	Space Shuttle Requirements for Preparation and Approval of Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL)		
	Ref. Para. 6.7i; Table 1; Apx B		
SLP 4.14	Corrective and Preventive Action JSC ONLY		
	Ref. Preface, Para. 4.2.9		
SSP 30223	Problem Reporting and Corrective Action for the Space Station Program		
	Ref. Preface, Para. 2.0; Table 1		
SSP 30234	Instructions for Preparation of Failure Modes and Effects Analysis and Critical Items List (CIL) for Space Station		
	Ref. Para. 6.7i; Table 1; Apx. B		
SSP 50431	Space Station Program Requirements for Payloads		
	Ref. Para. 2.0; Apx. B		

3.2 REFERENCE DOCUMENTS

The following JSC forms are referenced throughout this document:

JSC Form (JF) 2174, Failure Investigation Action Report

JF 2174A, Interim Selected Operation Disposition

JF 2174B, Linked Problem

JF 2174C, Corrective Action Implementation Pending (CAIP)

JF 2174D, Corrective Action Implementation Pending (CAIP) Closure

JF 2174E, Final Closure - Explained

JF 2174F, Final Closure - Corrective Action

JF 2174G, Final Closure - Non-Problem

JF 2174H, Final Closure - NASA Concurrence

4.0 REQUIREMENTS

4.1 PROBLEM REPORTING/NOTIFICATION

4.1.1 Reporting Criteria

A nonconformance that shall be reported into the JSC GFE PRACA system is one which involves a failure, overstress or potential overstress, unsatisfactory condition, Inflight Anomaly (IFA), unexplained anomaly, or a recurring nonconformance (identified with or without trend analyses) that requires recurrence control on flight hardware, equipment that is representative of flight hardware (flight-like), or critical GSE and occurs during one of the following events:

- a. Qualification/certification testing.
- b. Acceptance testing.
- c. In-service.
- d. Turnaround operations including ground test, overhaul, and repair.
- e. Any test involving hardware previously accepted by the government returned for repairs, modifications, etc.
- f. Shipping and receiving of hardware delivered to the government.
- g. Nonconformance evaluation shows previously accepted/delivered hardware is impacted.
- h. Nonconformance evaluation results in the identification of an adverse trend.
- NASA Advisory or Government Industry Data Exchange Program (GIDEP)
 Acute Launch Emergency Reliability Tip (ALERT) review identifies usage of the specified item.

In addition, nonconforming GFE software or firmware that is not under the control of a software control board, (e.g., Shuttle Avionics Control Board or the ISS Avionics and Software Control Board) and does not meet software requirements specification documentation shall be reported into the JSC GFE PRACA system. If the software is under the control of a board, problems shall be reported into that board's tracking system for evaluation and disposition.

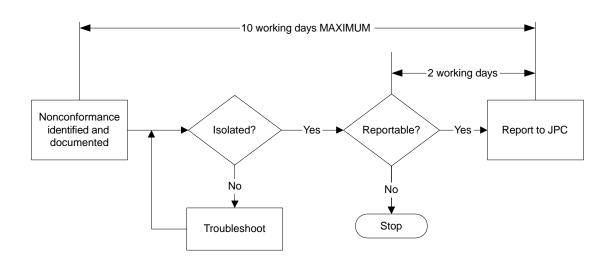
Contractors are responsible for initiating PRACA Problem Reports (PPRs) on equipment prior to delivery to and acceptance by the government. Contractors are responsible for initiating PPRs on equipment for which they have maintenance and operations responsibility. The JSC Safety, Reliability and Quality Assurance (SR&QA) Flight Equipment Division (FED) Quality Engineers shall initiate all other PPRs.

4.1.2 Timely Reporting

A nonconformance meeting the criteria of a reportable problem shall be formally reported to the JSC PRACA Center (JPC) within 2 business days after isolation to a configuration item, but no later than 10 business days after occurrence/detection of the problem (reference Figure 4-1). The Problem Resolution Team (PRT) shall forward the notification of the problem to other users of the identified item, including off-site contractors, when appropriate.

NOTE: The Projects Office Manager and the SR&QA FED Chief shall be notified as soon as possible, but no later than 24 hours after occurrence/detection, of any nonconformance which could potentially jeopardize the flight crew's safety, ground processing/testing crew's safety, or mission success.

FIGURE 4-1
PROBLEM REPORTING TIMELINE



4.1.3 Exclusions from Initiating a PPR

A nonconformance does not have to be formally reported into the PRACA system if, during the 10-day period, it can be verified that it meets the following:

- a. Operator error (procedures and training adequate, and no suspected overstress).
- Test set-up error (procedures and training adequate, and no suspected overstress).
- c. Defect is cosmetic in nature, i.e., does not affect form, fit, or function.

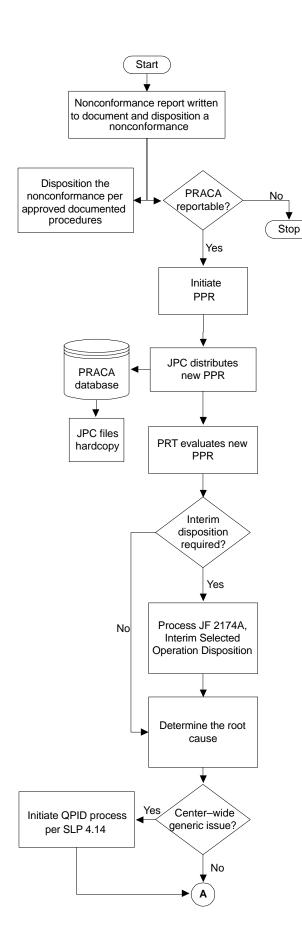
- d. The defect is dispositioned by an approved standard repair procedure documented and approved on a previous PPR, and there continues to be no need to implement recurrence control.
- e. Leakage exceeding specification requirements occurring as a result of system assembly/re-assembly which is resolved by routine procedures (recycling, retorquing fitting, line adjustment, etc.,) and no recurrence control is required.
- f. Items exceeding shelf life prior to installation.
- g. Documentation errors/squawks that did not affect the hardware performance and/or no tests were invalidated.

NOTE: Nonconformances meeting the criteria stated above may become reportable if they become repetitive. NASA reserves the right to request the initiation of a PPR for any specific instance.

4.1.4 Mission Evaluation Room (MER) Problem and Item for Investigation (IFI) List

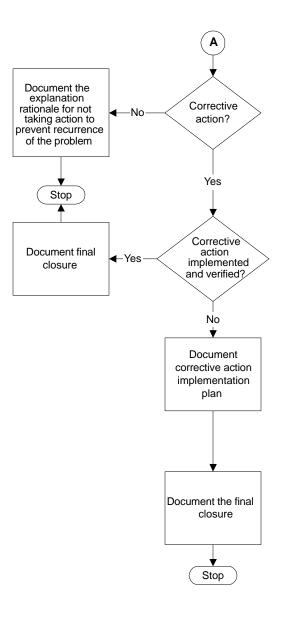
Nonconformance reports (e.g., Interim Discrepancy Reports or Discrepancy Reports [DRs]) shall be initiated against items identified on the MER Problem Tracking List (excluding "Funnies") or IFI listing. The described nonconformance shall be evaluated against the exclusion criteria, reference Paragraph 4.1.3. If after 10 working days it remains unclear as to whether or not a problem exists, a PPR shall be initiated based on the information provided by the MER.

4.2 PROBLEM RESOLUTION PROCESS



4.2.1 A nonconformance occurs and is documented and the appropriate personnel are notified per the procedures for controlling nonconforming product.

- **4.2.2** The appropriate personnel determine if the nonconformance is PRACA reportable. If the problem potentially jeopardizes the flight crew's safety, ground/test crew's safety or mission success, then the Project Office shall be notified as soon as possible, but not later than 24 hours.
- **4.2.3** The appropriate personnel shall initiate a PPR. The PPR shall be assigned a unique control number. The PPR shall be delivered to the JPC within 2 working days after isolation to a configuration item, but no later than 10 working days after the nonconformance occurred or was detected.
- **4.2.4** The JPC distributes the PRACA report to the appropriate personnel, enters the information in to the JSC PRACA database, and files a hardcopy.
- **4.2.5** The PRT shall evaluate the problem to determine if the problem has previously occurred and the impacts. If the problem is identical to another open problem, the new problem may be "linked" to the existing open problem using JF2174B, Linked Problem. If after further review, the PRT agrees that the problem does not fit the criteria for a reportable problem, it may be closed using JF2174G, Final Closure Non-Problem. JPC personnel shall update the PRACA database and file a hardcopy of the approved JF2174B or JF2174G.
- **4.2.6** The PRT is responsible for determining if the specific item or similar items are needed to support an upcoming launch, onorbit activity, or testing and providing an interim disposition to clear those activities. In the event the problem impacts those events, the Project Manager/Responsible Design Engineer (PM/RDE) shall notify the Project Office and JSC SR&QA as soon as possible.
- **4.2.7** The PM/RDE shall process a JF2174A, Interim Selected Operation Disposition. Approval of the JF2174A is the same as for a final closure, see Table 1. JPC personnel shall update the PRACA database and file a hardcopy of the approved JF2174A. The JPC shall maintain a status report tracking these problems.
- **4.2.8** The PRT shall develop, document, and agree to a plan to identify the root cause utilizing Test, Teardown, and Evaluation (TT&E) techniques and/or failure analyses. Other disciplines shall be brought in to support the PRT in the investigation (e.g., Electronic, Electrical, Electromechanical [EEE] parts engineers, material engineers, safety engineers, Mission Operations Directorate [MOD] representative).
- **4.2.9** The PRT shall determine if the problem is a generic process issue which may have center–wide impacts. The Projects Office Manager may request a Quality Performance Improvement Database (QPID) report be initiated per SLP 4.14, Corrective and Preventive Action. The QPID Report and the PPR shall cross reference each other. The Projects Office Manager may also copy PRACA information, regarding JSC corrective actions, into the QPID database for management visibility.



4.2.10 A decision to take corrective action shall be made based upon the magnitude of the problem and shall be commensurate with the risk of the problem recurring. In the event the decision is to not take action to prevent recurrence of the problem, the final closure (i.e., explnation) shall document the disposition of the article in question, the explanation rationale for not taking recurrence control, mission effects, operational workarounds, etc. For problems occurring on-site, the PM/RDE shall use JF 2174E, Final Closure - Explained. For vendor problems the PM/RDE shall attach JF 2174H, Final Closure - NASA Concurrence, to the vendor final report. JPC personnel shall update the PRACA database and file the hardcopy of the approved JF 2174E or JF2174H with the vendor report.

4.2.11 Once the root cause has been identified, the specific article in question dispositioned, and actions to prevent recurrence of the problem implemented and verified to be effective, the problem shall be closed. The PM/RDE shall complete JF 2174F, Final Closure - Corrective Action, for problems occuring onsite. For vendor problems, JF 2174H shall be attached to the vendor final report. JPC personal shall update the PRACA database and file the hardcopy of the approved JF 2174F or JF 2174H with the vendor report.

4.2.12 Once the root cause has been identified and the specific article in question dispositioned, but actions to prevent recurrence of the problem have not been implemented and/or verified to be effective, the PM/RDE shall use JF 2174C, Corrective Action Implementation Pending (CAIP), document and obtain approval of the plans and the estimated completion date for completing these activities. JPC personnel shall update the PRACA database and file the hardcopy of the approved JF 2174C. The JPC shall maintain an "Actions Pending" status report of these problems.

4.2.13 Final approval shall be documented on JF 2174D, Corrective Action Implementation Pending (CAIP) Closure, as specified in Paragraph 4.7.5, Note 5. JPC personnel shall update the PRACA database and file the hardcopy.

4.3 TIMELY DISPOSITIONS

The PM/RDE is responsible for ensuring a disposition per the requirements of this document.

4.3.1 Flight Readiness Review

All open problems must be dispositioned or closed prior to the next scheduled launch that involves the specific nonconforming hardware or like hardware that could potentially be impacted by the problem. Consideration must also be given to equipment already on-orbit. All problem dispositions or closures shall be submitted to the JPC as soon as possible, however the program FRR shall be used as the benchmark for defining timely dispositions. An Interim Selected Operation Disposition (JF 2174A) shall be processed immediately for new problems opened during the period commencing L-5 working days until launch.

For ISS hardware already in on-orbit operation, all new problems need to be evaluated for related safety hazards/concerns prior to the next on-orbit utilization. Objective evidence of this evaluation is an approved JF 2174A.

4.3.2 Test Readiness Review (TRR)

Open problems shall be evaluated at each TRR involving hazardous testing to identify and minimize risks to safety and success of the test.

4.4 FAILURE EFFECTS

When failed hardware has uses in multiple applications where the failure effect may be different for the same failure mode, the problem shall be treated as the worse case failure effect.

4.5 INTERIM DISPOSITION

4.5.1 Interim Selected Operations Disposition (ISOD)

An ISOD may be used to allow continued use of flight/flight-like hardware for training, testing, missions, or on-orbit operations prior to the completion of the problem investigation, the identification and implementation of corrective action. Program approved criteria are:

- a. The problem is not applicable to the specified mission(s)/operation(s), i.e., like hardware is not flying on the missions indicated, used on-orbit, or the test.
- b. The problem condition does not exist in the flight/on-orbit hardware and is clearly screened by preflight checkout or special test.

- c. The problem is time/age/cycle related and the flight/flight-like unit(s) will have accumulated less than 50% of the critical parameter(s) at the end of the next mission or specified usage.
- d. The problem is applicable to the mission (system installed and/or used onorbit); however the Program Office has been informed and agrees that sufficient substantiating evidence exists so the hardware in question can be flown and/or operated safely (as an accepted risk).

4.5.2 Additional Rationale

Should none of the preceding criteria apply, the following information shall be documented to address the consequences of the problem recurring in-service:

- a. Why it is acceptable to use the system/hardware without action to prevent recurrence of the problem. This shall include the last test to be conducted which could detect the problem prior to in-service usage, the effects should the problem recur in-service, methods of detection in-service, operational work-arounds, and methods of recovery.
- b. Impacts, if applicable, to Failure Modes and Effects Analysis (FMEA)/Critical Items List (CIL) retention rationale or hazard controls.

4.6 ROOT CAUSE

4.6.1 Root Cause Determination

Identification of the root cause of a problem is necessary to determine corrective action(s), i.e., recurrence control. TT&E to identify the nonconforming article is required for all reportable problems. When sufficient TT&E is performed to classify the problem as "in-family," additional failure analysis is at the discretion of the PRT. A failure analysis is required for all problems classified as "out-of family" where the failure effect could result in loss of crew or vehicle (functional Criticality 1, 1R, or 1S), loss of mission (functional Criticality 2 or 2R), or a launch scrub/schedule slip. For functional Criticality 3 "out-of-family" problems the need for failure analyses to identify the root cause of the problem is also at the discretion of the PRT. Reference Appendix B for definitions of "in-family" and "out-of-family" used in these contexts.

4.6.2 Off-the-Shelf (OTS) Equipment

OTS equipment is addressed with the same root cause determination rationale as identified in Paragraph 4.6.1.

4.6.3 Part Storage

For any situation where there is TT&E only, all removed piece parts, components, or assemblies shall be preserved when appropriate or as directed by the PRT. Preservation of the parts will allow failure investigation at a later date, if required, as a result of new evidence or adverse problem trends.

4.6.4 Maintenance Action Request (MAR)

After completion of the System Acceptance Review, ISS Integrated GFE (e.g., early communication) requires the completion and approval of a MAR documenting and authorizing the funding of the appropriate action(s). A copy of the approved MAR shall be attached to the PPR.

4.7 PROBLEM CLOSURE

4.7.1 Final Closure - Corrective Action Taken

The decision to take corrective action is based upon the magnitude of the problem and commensurate with the risks encountered should the problem recur while the equipment is in-service or during testing. Once the root cause has been identified and the following have been implemented, a problem may be closed:

- a. Remedial Action A description of the action(s) taken on the nonconforming item, (e.g., modify, recall, repair, rework, scrap). Also address spares, like units already in the field, etc.
- b. Document the troubleshooting/analyses and results.
- c. Root Cause The underlying reason for, or cause of, the problem identified through investigations, analyses, or studies which, when corrected, will prevent or reduce the recurrence of the problem.
- d. Recurrence Control Action The action taken to eliminate the root cause of the problem to prevent its recurrence.
- e. Verification of the implementation and effectiveness of the permanent corrective action.

4.7.2 Corrective Action Implementation Pending

After a root cause has been identified and technical agreement reached upon the necessary recurrence control action(s), a problem may be closed on an interim basis until the action(s) can be implemented and verified effective. Once verified, the problem

may be fully closed using JF 2174D. The following shall be addressed by the interim closure:

- a. Remedial Action A description of the action(s) taken on the nonconforming item, (e.g., modify, recall, repair, rework, scrap). Also address spares, like units already in the field, etc.
- b. Document the troubleshooting/analyses and results.
- c. Root Cause The underlying reason for, or cause of, the problem identified through investigations, analyses, or studies which, when corrected, will prevent or reduce the recurrence of the problem.
- d. Interim Action A description of temporary action(s) taken to alleviate the problem until the recurrence control action is implemented or rationale why it is acceptable to use the system/hardware without the recurrence control in place. This rationale shall include the last test to be conducted which could detect the problem prior to in-service usage, the effects should the problem recur inservice, methods of detection in-service, operational workarounds, and/or methods of recovery.
- e. Recurrence Control Action The planned activity to be implemented that will prevent recurrence of the problem.
- f. Estimated completion date for implementing the permanent corrective action and verifying its effectiveness. Address how this will be accomplished.

4.7.3 Final Closure (i.e., "Explained") - No Correction Action or Only Partial Corrective Action Taken

An explained problem closure shall be processed when a root cause cannot be determined or it's decided that it is appropriate to close the problem without implementing a recurrence control action. Unexplained anomalies shall be processed in this manner. The following criteria must be addressed in the explained closure:

- a. Remedial Action A description of the action(s) taken on the nonconforming item, (e.g., modify, recall, repair, rework, scrap). Also address spares, like units already in the field, etc.
- b. Troubleshooting/analyses and results.
- c. Root Cause (a most probable cause shall be identified for an unexplained anomaly).
- d. Explanation Rationale Document why it is acceptable to use the system/ hardware without action to eliminate the root cause to prevent recurrence of the

problem. This shall include the last test to be conducted which could detect the problem prior to in-service usage, the effects should the problem recur inservice, methods of detection in-service, operational workarounds, and/or methods of recovery.

- e. Problem History Document the failure history of the hardware as it relates to the problem in question with respect to the specific unit and to like units.
- f. Impact, if applicable, to FMEA/CIL retention rationale or hazard control.

4.7.4 "Linked" Problems

A newly reported problem may be closed on an interim basis by linking it to an existing open problem. The newly reported problem must be against the same configuration, exhibit the same failure mode, and be suspected of resulting from the same cause as identified on the existing open problem. Upon closure of the existing open problem, the linked problem shall have its coding revised to reflect updated information (coding, etc.) and closure status. For traceability purposes, each report shall cross-reference the other.

4.7.5 Required Approvals (Interim Disposition, Interim Closure and Final Closure)

The following matrix depicts the required approvals for interim disposition, interim closure and final closure.

TABLE 1
REQUIRED APPROVALS⁵

	Criticality ¹ 1 or 1R	IFA or U/A (Criticality ¹ 1, 1R, or 2)	U/A (Criticality ¹ 2R or 3)	Criticality ¹ 2, 2R or 3	Linked Problem
PM/RDE	X	X	X	Χ	Χ
SR&QA	X	X	X	Χ	X
Projects Office Manager (SSP Certificate of Flight Readiness Level Signature)	Х	Х			See Note 4
ISS Program Level I Approvals ²	See Note 2	See Note 2	See Note 2	See Note 2	
Other Disciplines ³	See Note 3	See Note 3	See Note 3	See Note 3	

- NOTES: 1. Criticality is based upon functional criticality per the NSTS 22206, Space Shuttle Requirements for Preparation and Approval of Failure Modes and Effects Analysis (FMEA) and Critical Items List (CIL), for the Space Shuttle Program (SSP) or SSP 30234, Instructions for Preparation of Failure Modes and Effects Analysis and Critical Items List (CIL) for Space Station, for the International Space Station Program.
 - A problem disposition and/or closure involving ISS integrated GFE or that affects a vehicle interface, shall be reviewed and approved by the appropriate ISS Program Review Board when the problem meets the Level 1 criteria specified in SSP 30223 (refer to Appendix B for definition of Level 1).
 - JSC EEE parts specialists shall approve all PRACA reports involving EEE parts problems. JSC materials and processes specialists shall approve all PRACA reports involving materials or special process problems. MOD personnel shall approve PRACA reports requiring new or revised flight rules.
 - 4. The Projects Office Manager shall be notified of the recurrence of a problem when it is linked to a currently open Criticality 1, 1R, or 1S problem.
 - 5. JF 2174D, Corrective Action Implementation Pending (CAIP) Closure, only require the SR&QA representative's signature when the corrective

action is implemented as stated in the plan and verified effective. Deviations from the plan require the same approvals that originally approved the plan (JF 2174C).

5.0 DATA TRANSFER TO PROGRAM PRACA DATABASES

GFE PRACA reports shall be made available to the SSP web-based program compliance assurance and status system and ISS PRACA databases on a daily basis, except for planned outages. Requirements for the transfer of PRACA reports from JSC GFE PRACA to ISS and SSP PRACA are defined in Interface Definition Agreements (IDAs). The IDAs define data transfer, communication circuits, system availability, system security, data backup requirements, and auditing procedures.

6.0 ORGANIZATIONAL RELATIONSHIPS AND RESPONSIBILITIES

6.1 SPACE SHUTTLE VEHICLE ENGINEERING OFFICE (SSVEO)

The manager of the SSVEO is responsible for:

- a. Designating projects office managers for flight crew equipment and remote manipulator system and providing a listing to the FED.
- b. Approving PRACA problem dispositions/closeouts per the matrix in Paragraph 4.7.5.
- c. Identifying and copying data regarding JSC corrective actions from PRACA into the QPID database for management visibility.
- d. Authorizing funds for corrective action, as needed.

6.2 EXTRAVEHICULAR ACTIVITY (EVA) PROJECT OFFICE

The manager of the EVA Project Office is responsible for:

- a. Designating project managers for the EVA hardware subsystems (extravehicular mobility unit, tools and crew aids, simplified aid for EVA rescue, etc.) and providing a listing to the FED.
- b. Approving PRACA problem dispositions/closeouts per the matrix in Paragraph 4.7.5.
- c. Identifying and copying data regarding JSC corrective actions from PRACA into the QPID database for management visibility.

6.3 INTERNATIONAL SPACE STATION PROGRAM (ISSP)

The ISSP or Deputy Program Manager are responsible for:

- a. Approving PRACA problem dispositions/closeouts per the matrix in Paragraph 4.7.5.
- b. Authorizing funds for corrective action, as needed.

6.4 ENGINEERING DIRECTORATE AND SPACE AND LIFE SCIENCES DIRECTORATE

The directors of Engineering and Space and Life Sciences are responsible for designating PM/RDEs for JSC GFE and providing a listing to the FED.

6.5 CONFIGURATION CONTROL BOARDS (CCBs)

CCBs are responsible for managing configuration of equipment. CCB Directive (CCBD) shall authorize configuration changes (permanent or temporary) to equipment. PPRs shall not be closed based solely on the issuance of a CCBD.

6.6 SR&QA OFFICE

The director of the SR&QA Office is responsible for designating SR&QA engineers to support the JSC GFE PRTs, the operation of the JSC GFE PRACA center and the JSC PRACA information system. The director of SR&QA shall provide a listing of SR&QA engineers supporting PRTs to FED. In addition, this office shall serve as the office of primary responsibility for the implementation of these requirements. This includes the following:

- a. Assuring the requirements of this document are defined and maintained with current program policies.
- b. Directing/participating in PRACA process audits to assure that JSC or contractor implementation processes are consistent with the requirements in this document and provide confidence in the integrity of the hardware and software.
- c. Advising the managers of the Space Shuttle and ISS Programs, EVA project, and SSVEO as regards to the risks related to problem resolutions.

6.7 PROBLEM RESOLUTION TEAM

After the problem is reported, a team approach shall be employed for problem processing, analyses and resolution. At a minimum, the PRT shall consist of the JSC PM/RDE and JSC SR&QA engineer assigned to the subject hardware. Additional personnel such as the hardware supplier/contractor engineers or other disciplines such as safety, materials, stress, EEE parts, MOD personnel, etc., shall participate as required. PRT decisions shall be unanimous. Appeals are to be worked starting at the division, then project, and finally at the program level. The team is responsible for:

- a. Reviewing and evaluating each problem to determine a disposition.
- b. Determining the impacts to ongoing operations or upcoming missions.
- c. Developing TT&E and/or failure analyses plans to identify and understand the root cause of a problem, and providing an estimated completion date (including obtaining MAR approval, when appropriate).
- d. Assessing each problem to determine if corrective action to eliminate the root cause of the nonconformance and preventing its recurrence is required.
- e. Ensuring the verification of the implementation and effectiveness of the corrective action(s).
- f. Approving problem report dispositions/closures.
- g. Ensuring the integrity of the data provided to the PRACA database for supporting future failure history investigations and/or trending efforts.

- Performing trending analyses to identify preventative or maintenance actions per NSTS 08126, Space Shuttle Problem Reporting and Corrective Action (PRACA) System Requirements.
- Evaluating FMEA/CILs for any undocumented failure mode revealed during problem investigation per NSTS 22206 or SSP 30234.

6.8 HARDWARE SUPPLIER/CONTRACTOR

Each JSC GFE hardware supplier/contractor is responsible for reporting problems when equipment is in their possession or they are contractually accountable, assigning engineers to support PRACA problem resolution activities, and to provide data as specified by this document and by the contract DRD.

6.9 PROJECT MANAGER/RESPONSIBLE DESIGN ENGINEER

The PM/RDE shall organize and chair the PRT. The PM/RDE is responsible for performing the following:

- a. Authorizing and directing investigations (TT&E/failure analyses) per PRT plan to determine the root cause of a problem (including obtaining MAR approval, when required).
- b. Documenting the PRT disposition for all PPRs.
- c. Providing status data to the JPC, such as an estimated completion date, within 30 days of problem initiation.
- d. Initiating interim disposition and/or appropriate problem closeout forms and securing required approval signatures.
- e. Identify and notifying other users of the afflicted hardware when there are multiple users.
- f. Obtaining review and approval of other disciplines, when necessary (reference Paragraph 4.7.5).
- g. Informing the Project Office and SR&QA of problems that could impact a launch, safety, and/or mission success.
- h. Presenting problem status, interim dispositions, and closures to Program Office(s), when required.
- i. Generating a new FMEA/CIL for any undocumented failure mode.

6.10 SR&QA ENGINEER

The SR&QA engineer shall support the PRT. The SR&QA engineer is responsible for performing the following:

- a. Ensuring the disposition of a nonconformance meets program and project requirements for safety, mission success, reliability and quality assurance.
- b. Verifying that each problem occurrence or its disposition/closure does not invalidate FMEA/CIL retention rationale or a hazard control.
- Tracking implementation of corrective action and submitting a CAIP closeout (JF 2174D) upon completion and verification of the effectiveness of permanent corrective action.
- d. Documenting PRACA trend codes, coordinated with the PM/RDE, for each problem report.
- e. Notifying the JPC of problems that could impact a launch, safety, and/or mission success.
- f. Providing the PPR control number to the MER safety console personnel for reference on IFAs or IFI.

6.11 PROJECTS OFFICE MANAGER

The Projects Office Manager is responsible for:

- a. Approving the PPR dispositions/closeouts per the matrix in Paragraph 4.7.5.
- b. Authorizing funds for corrective action as needed.
- c. Providing direction, as required, to hardware suppliers/contractors regarding actions necessary to comply with PRACA requirements.
- d. Providing a listing of PM/RDEs authorized to approve PPRs when the hardware is contractually transferred to the vendor/supplier.

6.12 JSC PRACA CENTER

The JPC is responsible for operating and controlling the JSC PRACA information system. The JPC shall:

- a. Maintain hardcopy files of open and closed problem reports.
- b. Update and maintain the electronic PRACA database system.
- c. Maintain the official listing of open JSC GFE problems; maintain a copy of the lists of JSC Project Office managers, PM/RDEs, and SR&QA engineers supporting PRTs provided to the FED.
- d. Ensure the daily transfer of PRACA data to the ISS and SSP PRACA databases per the IDAs.

APPENDIX A ACRONYMS AND ABBREVIATIONS

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ACRONYMS AND ABBREVIATIONS

CAIP Corrective Action Implementation Pending

CCB Configuration Control Board

CCBD Configuration Control Board Directive

CIL Critical Items List

DR Discrepancy Report

DRD Data Requirements Document

EEE Electronic, Electrical, Electromechanical

EVA Extravehicular Activity

FED Flight Equipment Division

FIAR Failure Investigation Action Report FMEA Failure Modes and Effects Analysis

FRR Flight Readiness Review

GFE Government Furnished Equipment

GSE Ground Support Equipment

IDA Interface Definition Agreement

IFA In-flight Anomaly
IFI Item for Investigation

ISOD Interim Selected Operations Disposition

ISS International Space Station

ISSP International Space Station Program

JF JSC Form

JPC JSC PRACA Center

JPRCB Joint Program Requirements Control Board

MAR Maintenance Action Request MER Mission Evaluation Room

MOD Mission Operations Directorate

OOA On-Orbit Anomaly

OTS Off-the-Shelf

PM/RDE Project Manager/Responsible Design Engineer

PPR PRACA Problem Report

PRACA Problem Reporting and Corrective Action

PRT Problem Resolution Team

QPID Quality Performance Improvement Database

SLP System Level Procedure

SR&QA Safety, Reliability and Quality Assurance

SSP Space Shuttle Program

SSVEO Space Shuttle Vehicle Engineering Office

TRR Test Readiness Review

TT&E Test, Teardown, and Evaluation

APPENDIX B

GLOSSARY

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GLOSSARY

<u>Acceptance Testing</u> - Tests to determine that a part, component, subsystem, or system is capable of meeting performance requirements prescribed in purchase specifications or other documents specifying what constitutes the adequate performance capability for the item in question.

<u>Anomaly</u> - An unexpected event, hardware or software damage, a departure from established procedures or performance, or a deviation of system, subsystem, and/or hardware or software performance outside certified design/performance specification limits.

<u>Certification</u> - Qualification tests, major ground tests, other tests and analysis required to determine that the design and manufacturing process of hardware from component through the subsystem level meets requirements.

<u>Closed Problem</u> - The final disposition of a problem that has been approved by the government per Paragraph 4.7.5.

<u>Configuration Item</u> - An aggregation of hardware or software that satisfies an end function and is designated by the government for separate configuration management.

<u>Critical GSE</u> - GSE necessary to support the program, the failure of which could cause loss of vehicle system, GFE, or loss of personnel capability. In addition, GSE used in direct contact with hypergolic, cryogenic, explosive, flammable, toxic, corrosive, or harmful material or fluids; equipment using ordinance devices or devices used for ordinance checkout; equipment using high internal pressure, high electrical energy, high-flow volume, or high temperature or radiant energy; equipment with high speed dynamic components in its operation, hoisting/lifting and handling equipment are considered to be critical. This definition includes electrical equipment that operates in areas where flammable gases and/or vapors may be present or where electrical equipment is used for control of critical GSE. This also includes personnel rescue equipment.

<u>Critical Items List</u> - A list meeting the requirements of NSTS 22206 or SSP 30234 for critical items.

Criticality - The criticality categories are "functional," and "hardware," as defined below:

a. Functional Criticality - Categorization of the effect of loss of all redundancy (like and/or unlike) for a given function. Functional criticality is based upon multiple

failures that must occur to result in loss of the system or component function. Any hardware item in the failure scenario contributing to or resulting in the effect shall be considered as "redundancy." Functional criticality categories are as follows:

Criticality	Potential Effect of Failure
1	Single failure that could result in loss of life or vehicle.
1R	Redundant hardware item(s), all of which if failed could cause loss of life or vehicle. (NOTE: For GSE, this criticality is defined as "two redundant hardware items, which if both failed, could result in loss of life or vehicle.")
1S	A single failure in a safety or hazard monitoring system that could cause the system to fail to detect, combat, or operate when needed during the existence of a hazardous condition and could result in loss of life or vehicle.
2	Single failure that could result in loss of mission. (NOTE: For GSE, this criticality is defined as "single failure which could result in loss [damage] of a vehicle system.")
2R	Redundant hardware item(s), all of which if failed, could cause loss of mission (not applicable to GSE).
3	All others.

 b. Hardware Criticality - Categorization of the singular effect of the identified failure mode of a hardware item. Hardware criticality categories (not applicable to GSE) are as follows:

Criticality	Potential Effect of Failure
1	Loss of life or vehicle.
2	Loss of mission or next failure of any redundant item could cause loss of life/vehicle.
3	All others.

<u>Discrepancy</u> - Any nonconformance of an item which does not affect form, fit, or function, does not require recurrence control; and the item can be returned to an acceptable

condition through such actions as remove and replace, return to print, or repair in accordance with an approve procedure.

<u>Explained Problem</u> - A problem for which the government has approved the rationale for not implementing corrective action (recurrence control).

<u>Failure</u> - The inability of a system, subsystem, component, or part to perform its specified function within specified limits, under specified conditions, and for a specified duration.

<u>Failure Analysis</u> - That effort of physical inspections, tests (destructive or nondestructive), and/or analytical processes required to determine the root cause of a failure and identify the necessary corrective actions to prevent recurrence of the failure.

<u>Failure Investigation Action Report</u> - JSC Form 2174 series; used to formally document problems, as defined in Paragraph 4.1.1, on GFE for which JSC has prime responsibility.

Failure Mode - A description of the manner in which an item can fail.

<u>Failure Modes and Effects Analysis</u> - A description of the manner in which an item can fail and the resulting effects on the system, interfacing systems, mission, and crew/vehicle.

<u>Fit</u> - The ability of an item to physically interface or interconnect with or become an integral part of another item.

<u>Flight Constraint</u> - A flight constraint is a problem that poses an unacceptable risk to flight safety or mission success.

<u>Flight-like Hardware</u> - Non-flight equipment that is built with any combination of the following:

- a. Manufacturing processes that are identical or significantly similar* to those utilized in flight equipment.
- b. Contain parts or assemblies that are identical or significantly similar* in design to flight hardware (includes manufacturing processes at the piece part level).
- c. Equipment whose design (electrical or mechanical) is identical or significantly similar* to flight equipment when such design is critical to functional performance.

*Significantly similar is defined as commonality between parts, processes, or design such that the differences have no impact on the final performance of the equipment. (e.g., solder, SN60 versus SN63) or make no difference to eventual equipment performance.

NOTE: Hardware built with non-flight parts; i.e., commercial, etc., should be considered flight-like unless there are additional significant differences.

<u>Form</u> - The shape, size, dimensions, mass, weight, and other visual parameters which uniquely characterize an item. For software, form denotes the language and media.

<u>Function</u> - The action or actions, which an item is designed to perform.

<u>Generic Problem</u> - A problem condition that exists or could exist on any or all components of like or similar design.

Government Furnished Equipment - Flight or flight-like equipment certified by the government for use in NASA programs. This includes hardware and software designed, developed, and manufactured or produced by the government, procured from a source with a contract other than the ISSP or the SSP prime contract, and OTS equipment.

<u>Ground Support Equipment</u> - Ground-based equipment functionally designed to support flight hardware servicing, checkout, test, movement, alignment, protection, or calibration.

<u>In-family Problem</u> - A reportable problem that has been previously experienced, analyzed, understood, and was closed with the explanation that corrective action to prevent recurrence of the problem was not required. Recurrence of a problem prior to the implementation of corrective action, documented on a JF 2174C, may also be "infamily."

<u>In-flight Anomaly</u> - A term used by the SSP to describe an anomaly believed to have occurred in the interval beginning at the start of cryogenic tanking (approximately T-6 hours) and ending with specific mission termination boundaries. The mission termination boundary for GFE is at crew egress. An IFA may be detected during prelaunch and flight operation, during post-flight inspections, during post-flight measured data evaluation, or during post-flight hardware refurbishment. These are initially documented and tracked by MER problem reports.

<u>In-service</u> - The utilization or operation of equipment as it was specified, designed or intended. This includes the use of the equipment during training exercises or during testing. Examples are flight operations, integrated testing, etc.

<u>Item for Investigation</u> - A report used by the MER to document and track ISS On-Orbit Anomalies (OOAs).

<u>Level 1 Criteria</u> - The ISSP criteria for determining which PRACA problems must be reviewed and approved by the program. Level 1 problems are those meeting any one of the following criteria:

- a. The failure effect criticality is 1, 1R, 1S, 1SR, 1P, 2, or 2R and
 - 1. The root cause cannot be identified;
 - 2. Corrective or recurrence control actions, although appropriate for the problem, will not be implemented;
 - 3. PRT recommends termination of failure investigation prior to firm determination of root cause;
 - 4. The problem is not detectable at qualification testing, acceptance testing or inspection, or during the normal service of the component; or
 - 5. The problem condition is not fully restored to compliance and a "use as is" disposition is proposed.
- b. The problem occurrence or its resolution impacts a launch schedule or on-orbit assembly sequence;
- c. The problem affects a functional/physical interface between ISS prime contractor, payload, non-JSC GFE, and/or International Partner/provider hardware;
- d. The problem affects common hardware used by payloads (per SSP 50431); or
- e. PRT determines that Level 1 approval is required.

<u>Line Replaceable Unit</u> - An item whose replacement constitutes the optimum organizational maintenance repair action for a higher indenture item, i.e., any assembly that can be removed and replaced as unit from the system at the operating location.

<u>Nonconformance</u> - A condition of any article or material in which one or more characteristics do not conform to requirements (includes discrepancies and problems).

On-Orbit Anomaly - Term used by the ISSP to identify an anomaly occurring on-orbit. For GFE, an OOA may be detected during post-flight inspections, during post-flight measured data evaluation, or during post-flight hardware refurbishment.

Off-the Shelf - Hardware that has an existing heritage and usually originates from one of several sources which include commercial vendors as well as NASA and military suppliers. Categories include the following:

- a. Commercial OTS (designed and manufactured for a commercial application);
- Military OTS (designed and manufactured for military use); or
- c. NASA OTS (designed and manufactured for a NASA program other than the one for which the device is being proposed).

<u>Out-of-Family Problem</u> - A reportable problem that has not been previously experienced or that has been previously experienced but was either not well understood (e.g., unexplained anomaly) or the corrective action taken was not effective.

<u>Overstress</u> - A value of any stress parameter in excess of the upper limit of the normal working range or in excess of rated value as defined in the procurement specification.

<u>Potential Constraint</u> - Any open or incomplete activity that could cause a safety or mission completion concern or issue if not resolved or completed prior to the milestone event.

<u>PRACA Problem Report</u> - A generic term used to describe the official report used to document a problem meeting the requirements of this document, e.g., FIAR. This report typically comes after the initial nonconformance report, e.g., JSC DR or vendor's nonconformance report.

<u>Problem Reporting and Corrective Action</u> - A management system for identifying, reporting, analyzing for cause, remedying, and preventing recurrence of problems.

<u>Process Escape</u> - Any problem found after it should have been detected during normal processing. Escapes include problems found during surveillance sampling, inspection (including random), or audit after closeout or test. Also, if an assessment determines that the problem would not have been caught during closeout or test, the problem will be considered a process escape.

<u>Project Manager/Responsible Design Engineer</u> - The JSC Engineering Directorate or Space and Life Sciences engineer responsible and accountable for the hardware or software. The PM/RDE is responsible for directing failure investigations, documenting investigation results, and the dispositioning of all PRACA paperwork.

<u>Qualification Tests</u> - Those tests conducted as a part of the certification program to demonstrate that design and performance requirements can be realized under specified conditions.

<u>Recurrence Control</u> - The action taken to eliminate the root cause of a problem to prevent its recurrence in existing or future hardware.

<u>Remedial Action</u> - The action taken on the specific nonconforming item (e.g., modify, recall, repair, rework, scrap).

<u>Root Cause</u> - The underlying reason for, or cause of, the problem identified through investigations, analyses, or studies, which when corrected, will prevent or reduce the recurrence of the problem.

<u>Safety-Related Problems</u> - Criticality 1 and 1R problems, which could result in loss of life or vehicle.

<u>Screenable Problem</u> - A problem for which there is an adequate screen to prevent recurrence of the problem. Adequate screen is defined to mean (1) the performance of a test/inspection would always detect the problem prior to use, and (2) the problem would not occur subsequent to the test/inspection.

<u>Standard Repair</u> - A documented repair method, approved by the Material Review Board or PRT, for dispositioning a specific type of hardware nonconformance. For commercial OTS, the manufacturer's User's Notes or Troubleshooting Guide may suffice.

<u>Test, Teardown, and Evaluation</u> - The effort required to disassemble, test, and determine which assemblies, subassemblies, parts, or components failed or malfunctioned and to define the work required to return the failed unit to a condition complying with governing specifications.

<u>Unexplained Anomaly</u> - An anomaly that cannot be repeated (phantom or ghost) or for which a cause cannot be determined.

<u>Unsatisfactory Condition</u> - Any nonconformance for which engineering resolution is required and which requires recurrence control beyond the specific article under question. Included in this definition are:

- a. Conditions which cannot be corrected to the specified configuration using standard repair procedures; or
- An event which could lead to a failed condition but does not affect the function of the article such as contamination, corrosion, workmanship error, process escape, etc.

<u>Waiver/Deviation</u> - The granted use or acceptance of an article that does not meet specified requirements. A waiver is given or authorized after the fact; a deviation is before the fact.